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Introduction

Pain is an integral part of sports participation and can set a limit on what athletes are able to achieve (Epstein, 2011). Athletes regularly experience pain while training and competing through injury, contact with external objects, and exertion. The ability to maintain performance in painful conditions is crucial to continued participation in most sports and is a deciding factor in whether an athlete is successful or not (Egan, 1987). A substantial body of research has focused on pain tolerance and pain thresholds, with most finding that athletes are able to tolerate more pain than non-athletes (Geva and Defrin, 2013; Ryan and Kovacic, 1966; Ryan and Foster, 1967). Indeed, a systematic review and meta-analysis Tesarz, Schuster, Hartmann, Gerhardt and Eich, 2012) found that athletes possessed higher pain tolerance compared to normally active controls.

Athletes are required to maintain performance levels while experiencing pain, but there is a paucity of research focusing on how pain affects performance in motor tasks. To date, few studies have examined the effect of pain on motor performance and consequently there is no established relationship. One study has shown that pain enhanced performance on a simple hand-pumping task (Evans and McGlashan, 1967) with the authors suggesting participants “gritted their teeth” and got on with the task in order to endure the pain. However, other studies exploring the effect of pain on performance of similar simple motor tasks have found that pain reduced muscle strength (Farina, Arendt-Neilsen and Graven-Neilsen, 2005). The complexity of these relationships is further illustrated when task complexity is examined. For example, Brewer, Van Raalte and Linder (1990) used a simple bench press task, a simple golf putting task and a more complex golf putting task to examine performance in pain. Results indicated that pain did not impede performance in the simple tasks whereas the complex golf putting task performance was severely hampered by pain. These findings suggest that pain diverted attention away from the task at hand, and in the more complex task, performance suffered because the resources available to concentrate on the task were stretched.

Given that athletes have greater pain tolerance than non-athletes (Tesarz et al., 2012) it is surprising that only one study has compared performance in pain across athlete and non-athlete groups. Walker (1971) found that performance during a neuromuscular task was adversely affected by pain in both athletes and non-athletes. However, athletes whose team had a superior record for the season had higher pain tolerance than less skilled athletes, suggesting that there may be intra-athlete differences.

One factor determining pain tolerance may be the type and quantity of sport played (Assa, Geva, Zarkh and Defrin, 2018). Athletes who are exposed to pain through contact or ischemia may adapt to it. Indeed, there is evidence that endurance and strength athletes tolerate more pain than non-athletes (Assa et al., 2018; Geva and Defrin, 2013; Tesarz, Gerhardt, Schommer, Treede and Eich, 2013). Moreover, studies have shown that athletes who are engaged in high levels of training and competition tolerate more pain than recreational participations (Scott & Gisbers, 1981; Ord & Gijsbers, 2003). Indeed, studies examining conditioned pain modulation have found that more experienced, high level athletes exhibit enhanced conditioned pain modulation in comparison to lower level athletes (Flood, Waddington, Thompson & Cathcart, 2017). Athletes who participate in contact sports also tolerate more pain than non-contact athletes (Ryan & Kovacic, 1966). In addition, athletes new to contact sport show increased pain tolerance over a season compared to those who stop participation, indicating that there may be an adaptation effect to pain (Thornton, Sheffield and Baird, 2017). In addition, contact athletes have been shown to report pain as less intense than non-contact athletes (Raudenbush et al., 2012). Taken together, the corpus of research suggests that athletes, and in particular those who experience pain regularly (for example, contact athletes), tolerate more pain than other groups and find that pain less intense. This may help to explain how such athletes are able to function well despite undergoing high levels of pain. However, no study has examined how both motor and cognitive performance is affected by pain in different athlete and non-athlete groups.

Various explanations for enhanced pain tolerance in contact athletes have been posited, such as coping strategy use, ignoring pain or team culture (DeRoche, Woodman, Stephan, Brewer & LeScanff, 2010). For example, high risk and injury potential athletes (rodeo athletes) catastrophize less about pain than low injury potential athletes (Meyers, Bourgeois & LeUnes, 2001). As such, they do not ruminate about pain and approach it in a positive manner. Contact athletes also may become desensitized to pain over time due to experience and ignoring pain (Raudenbush et al., 2012), meaning that they can focus their attention on performance, not pain. Indeed, Rollman (1979) states that previous experience of pain moderates pain reports in his Adaptation Level Theory. In line with Attentional Control Theory (Eysenck, Derakshan, Santos & Calvo, 2007) if an athlete is anxious either because they are worried about the potential of pain, or how the pain is making them feel, this may result in attentional resources being reduced and greater attention being paid to the pain symptoms (e.g., threat related stimuli) to the detriment of their performance. Finally, the culture of playing hurt or "taking one for the team" is prevalent in contact sports (Liston, Reacher, Smith & Waddington, 2006). This may impact on the willingness to undergo experimental pain, and contact athletes may be reluctant to report pain sensation and may attempt to "beat the tests" in order to show pain tolerance (Manning & Fillingim, 2002).

The aim of this study is to examine performance in pain among high contact athletes, low contact athletes and non-athletes. We hypothesised that high-contact athletes' performance will be hampered less when in pain relative to no pain, compared to low-contact athletes and non-athletes. Performance was assessed on a motor task and cognitive task. We expected that differences would be greater on the motor task because high-contact athletes would be more experienced in performing motor tasks in pain, i.e. they had learnt to cope with performing in pain (cf. Thornton, Sheffield & Baird, 2017). We also hypothesised that, in pain, high-contact athletes would perform better as task complexity increased when compared to low-contact athletes and non-athletes. Finally, we hypothesised that high-contact athletes would have higher pain tolerance than low-contact athletes and non-athletes.

Methods

Design

A 2x2x2x3 mixed design was used. The independent variables were pain condition (pain or no pain, within subjects), task type (motor task or cognitive task, within subjects), task complexity (easy or hard, within subjects) athletic status (high contact athlete, low contact athlete and non-athlete, between subjects) and the dependent variables were performance in the motor and cognitive tasks, time taken to complete the motor task and subjective pain ratings.

Participants

Seventy-one males aged between 18 and 25 (*M* =20.3 years, *SD* = 1.9 years) were recruited via a Virtual Learning Environment and notice boards around a further education college. High contact athletes (N = 25, *M* age = 20.4 years, *SD* = 2.3 years) were recruited from sports where contact is essential and allowed within the rules, specifically rugby league (N = 7), rugby union (N = 10), American football (N = 1), martial arts (N = 4) Gaelic football (N=2) and hurling (N = 1). The low contact athlete group (N = 25, *M* age = 20.2 years, *SD* = 1.9 years) were regular exercisers (N=17) who participated in some form of training or exercise at least three times per week but did not report taking part in competitive sport, and athletes who participated in sports where contact is not allowed as part of the rules, specifically, tennis players (N= 3), badminton players (N=3) and trampolinists (N = 2). Non-athletes (N = 21, *M* age = 20.1 years, *SD* = 1.7 years) were participants who reported that they did not take part in any structured sport or exercise. All participants were in good health, assessed via the Physical Activity Readiness Questionnaire (PAR-Q) (Thomas, Reading and Shephard, 1992) and were pain and injury free at the time of testing. Exclusion criteria for this study were those suffering from Reynaud's disease or any injury to the foot and/or ankle area (von Baeyer, Piira, Chambers, Trapanotto and Zeltzer, 2005).

Procedure

Institutional ethical approval was granted for the study and after providing informed consent participants carried out four tasks (motor task easy, motor task hard, cognitive task easy and cognitive task hard). These tasks were completed both in pain and not in pain. The order of tasks and the pain conditions (pain or no pain) were randomised using a Latin square to control for order and carry-over effects with easy and hard versions of each task following one another. All tasks were completed alone so participants could not see what others were doing. Each task was performed three times and the mean score was calculated.

The easy motor task involved participants throwing a tennis ball at numbered targets in the correct order (one to ten). The targets were 29.6 cm by 21.0 cm. Performance was measured in terms of the number of targets hit and the time taken to throw the ball at all ten targets in the correct order. Participants were given one throw at each target, after which they moved on to the next numbered target in the sequence regardless of whether they hit the target or not. For the difficult condition, ten extra targets were added which were not to be attended to. These comprised of letters, symbols and inverted numbers. Participants were seated throughout each task at a distance of five metres from the targets and were instructed to try to be as accurate as possible but also to try to complete the task as quickly as possible in order to ensure that there was no trade off of accuracy for time. All targets were placed in the same way on the wall for all participants and were occluded until the test so that participants were not able to memorise where each target was.

The cognitive task has been previously used with athletes (Greenlees, Thelwell and Holder, 2006) and was a grid containing the numbers one to twenty-five in a randomised order. Participants were asked to find the numbers in the correct order and tick them off with a pen. Performance was measured in terms of how quickly the participants completed this task. Task difficulty was again manipulated for the hard condition by adding in 25 extra numbers which the participants did not need to attend to. The grid was occluded until the test so that participants were not able to memorise the position of each number. All participants used the same grid in the same room and were seated.

Participants completed the no pain tasks while seated. During pain conditions participants remained seated and placed their dominant foot in iced water. The cold pressor consisted of a 12-litre tank of circulating water and ice. Temperature was regulated using a thermometer to ensure that the water remained between 2-3^{o}C. Participants were informed that they were able to remove their foot at any time from the water if they could not bear the pain. Visual Analogue Self-Report Scales (VAS) were used to measure pain at the end of each task. This consisted of a 10 cm horizontal line with anchors at each end indicating the severity of the pain, these ranged from 0 (no pain), to 100 (the most pain imaginable). The participant was required to place a mark on the line to indicate the level of pain they were experiencing. A measurement was then taken, in millimetres, from the no pain end of the scale to the mark made by the participant. Such scales have proved to be reliable and valid for measuring the intensity of acute pain (Bijur, Silver and Gallagher, 2001). After each task, participants were asked how much effort they expended using a 10-point Likert scale (Evans and McGlashan, 1967).

At the conclusion of the testing, participants were asked to complete a questionnaire which required them to state the amount of perceived effort put in during each task, their regular sport, years of experience and number of major and minor injuries sustained.

Analytic Strategy

After checking for parametric assumptions, pain intensity was analysed separately for motor and cognitive tasks using 2 (pain – no pain) x 2 (task difficulty) x 3 (athletic status) mixed ANOVAs. Three separate 2 (pain – no pain) x 2 (task difficulty) x 3 (athletic status) mixed ANOVAs were used to analyse performance on the motor and cognitive tasks. Univariate ANOVAs and Bonferroni tests were used to examine differences *post-hoc*. To aid interpretation, η^2 values of .01, .06 and .14 are described as small, medium and large effects, respectively (Cohen, 1988, p.286-7).

Results

A total of seven participants withdrew from the cognitive task pain condition (1 high contact athlete; 4 low contact athletes; 2 non-athletes), whereas no-one withdrew from the motor tasks; this is reflected in the varying degrees of freedom reported. Descriptive data are shown in Table 1. There were no significant differences in age/experience across the groups.

Visual Analogue Scale (VAS) – Pain intensity ratings.

A 2 (task difficulty) * 3 (athletic status) mixed ANOVA was conducted for the motor task. There was a significant main effect for athletic status $F_{(2,68)} = 26.435$, $p < 0.001$, $\eta^2 = 0.44$, a large effect. High contact athletes reported lower pain intensity than low-contact athletes (who included regular exercisers) and non-athletes ($p < .001$); low-contact and non-athletes did not differ. There were no other significant effects. A 2 (task difficulty) * 3 (athletic status) mixed ANOVA was run for the cognitive task. Again, there was a significant main effect for athletic status $F_{(2,68)} = 17.634$, $p < 0.001$, $\eta^2 = 0.34$, a large effect. High contact athletes reported lower pain levels than low-contact athletes and non-athletes ($p < .001$); low-contact and non-athletes did not differ. There were no other significant effects.

Motor Task Performance: Targets Hit

A 2 (pain – no pain) * 2 (task difficulty) * 3 (athletic status) mixed ANOVA revealed a significant pain condition by athletic status interaction, $F_{(2,68)} = 8.68$, $p <.001$, $\eta^2 = 0.08$, a medium effect. The pain by athletic status interaction is displayed graphically in Figure 1. To explore this interaction three separate ANOVA were conducted in which the performances of contact, low-contact and non-athletes in no-pain and pain conditions and easy and difficult conditions were compared. In high-contact athletes there were no significant differences in performance in pain and no-pain conditions, $F_{(1,24)} = 3.86$, $p = .06$, $\eta^2 = 0.07$, whereas both the low-contact athletes, $F_{(1,24)} = 12.85$, $p < .001$, $\eta^2 = 0.13$, and non-athletes, $F_{(1,20)} = 6.67$, $p = .02$, $\eta^2 = 0.07$, performed significantly worse in the pain conditions than the no pain conditions.

There was also a difficulty by athletic status interaction, $F_{(2,68)} = 5.23$, $p <.01$, $\eta^2 = 0.04$; in high-contact athletes there were no significant differences in performance in the difficult and easy conditions, $F_{(1,24)} = 0.69$, $p > .10$, $\eta^2 = 0.01$, whereas both the low-contact athletes, $F_{(1,24)} = 15.24$, $p < .001$, $\eta^2 = 0.13$, and non-athletes, $F_{(1,20)} = 6.36$, $p = .02$, $\eta^2 = 0.12$, performed significantly worse in the difficult condition. There was also a significant main effect of difficulty, $F_{(1,68)} = 9.62$, $p = .003$, $\eta^2 = 0.04$; performance was lower in the more difficult condition. The main effect of pain condition was not significant, $F_{(1,68)} = 2.77$, $p = .10$, $\eta^2 = 0.01$. There were no other significant effects.

Motor Task Performance: (Time in seconds)

There was a significant pain condition by athletic status interaction, $F_{(2,68)} = 3.79$, $p = .03$, $\eta^2 = 0.02$, a small effect. The pain by athletic status interaction is displayed graphically in Figure 2. Three separate ANOVA were conducted in which the performances of contact, low-contact and non-athletes in no-pain and pain conditions and easy and difficult conditions were compared. In high-contact athletes there were no significant differences in performance time in pain and no-pain conditions $F_{(1,24)} = .69$, $p > 0.1$, $\eta^2 = 0.007$, a small effect, whereas both the low-contact athletes, $F_{(1,24)} = 4.53$, $p = .04$, $\eta^2 = 0.03$, a small effect, and non-athletes, $F_{(1,20)} = 13.15$, $p = .002$, $\eta^2 = 0.08$, a medium effect, performed significantly more slowly in the pain condition.

There was also a difficulty by athletic status interaction, $F_{(2,68)} = 3.18$, $p = .05$, $\eta^2 = 0.04$; high-contact $F_{(1,24)} = 16.90$, p < 0.001, $\eta^2 = 0.27$, and low-contact athletes, $F_{(1,24)} = 17.606$, $p < 0.001$, $\eta^2 = 0.30$, took significantly longer in the difficult conditions compared to the easy conditions but there was no significant difference for non-athletes $F_{(1,20)} = 1.972$; p > 0.05, $\eta^2 = 0.03$. There was also a significant main effect of pain condition, $F_{(1,68)} = 4.28$, $p = .05$, $\eta^2 = 0.01$; performance was slower in the pain condition. There was a main effect of task difficulty, $F_{(1,68)} = 32.25$, $p < .001$, $\eta^2 = 0.18$; performance was slower in the more difficult condition. Finally, there was a significant main effect of athletic status, $F_{(2,68)} = 5.04$, $p = .009$, $\eta^2 = 0.13$, a large effect; post-hoc Bonferroni tests revealed the high-contact athletes performed more quickly than low-contact athletes and non-athletes ($p < .05$), but low-contact athletes and non-athletes did not differ. There were no other significant effects.

Cognitive Task Performance: Time Taken

There was a task difficulty by athletic status interaction, $F_{(2,61)} = 9.04$, $p < .001$, $\eta^2 = 0.03$. The difficulty by athletic status interaction is displayed graphically in Figure 3. All participants took longer to complete the difficult tasks, compared to the easy conditions (all p< 0.001); high-contact athletes took longer to complete the difficult version of the task than low-contact athletes and non-athletes ($p < .05$), but there were no differences in the easy condition. There was also a significant main effect of difficulty, $F_{(1,61)} = 561.05$, $p < .001$, $\eta^2 = 0.82$; again, performance was lower in the more difficult condition. There were no other significant effects.

Effort

A repeated measures ANOVA (task type x pain x athlete status) to examine differences in effort revealed that the main effect of pain condition was significant, $F_{(1,67)} = 29.01$, $p <.001$, $\eta^2 = 0.30$: participants put in more effort in pain condition than the no pain condition (means± SDs = 8.30±1.37 vs. 7.42±1.64, respectively). There was also a main effect of task type, $F_{(1,67)} = 4.76$, $p =.03$, $\eta^2 = 0.07$: effort was rated higher in the motor task than the cognitive task (means± SDs = 8.30±1.37 vs. 7.42±1.64, respectively. Finally, there was task by group interaction, $F_{(2,66)} = 4.17$, $p < .02$, $\eta^2 = 0.11$; post-hoc Bonferroni tests revealed that only high-contact athletes put in more effort in the motor task (mean±SD = 8.63±1.32) than the cognitive task (mean±SD = 7.92±1.34).

Discussion

This study was designed to examine differences in performance between high and low contact athletes (who included regular exercisers) and non-athletes in pain and no-pain, motor and cognitive tasks. Cold pressor pain was reported as less intense by high-contact athletes during both tasks compared to low-contact athletes and non-athletes. High-contact athletes' performance was also not hampered by pain on the motor task whereas the performance of low-contact athletes and non-athletes was; importantly, performance was both slower and poorer in the pain condition. However, pain did not hamper performance for any group during the cognitive task. Low-contact and non-athletes did not differ from each other in their pain reports or the degree to which their performance was hampered by pain in either task. High-contact athletes performed better on the motor task as task complexity increased when compared to low-contact athletes and non-athletes, but these differences were not larger in the pain condition. Participants reported greater effort in the pain conditions than no pain conditions; the high-contact athletes also reported more effort in the motor task than the cognitive task.

The hypothesis that high contact athletes would have lower pain intensity reports than low and non-contact athletes was supported. Many studies have found that athletes report less pain or have high pain tolerances than non-athletes with a meta-analytic review of 15 studies confirming that athletes have higher pain tolerances than non-athletes (Tesarz et al., 2012). Fewer studies have examined differences between athlete groups. In an early study, Ryan and Kovacic (1966) found that high-contact athletes had greater pain tolerance to two tasks than non-contact athletes and non-athletes and these findings have been corroborated by some (e.g. Raudenbush et al., 2012), but not all, research (Egan, 1987). Two previous studies examined differences in pain reporting amongst athlete groups found that contact sports participants perceived pain as less intense than non-contact athletes (Raudenbush et al., 2012; Straub, Martin, Williams and Ramsay, 2008). This supports Rollman's (1979) adaptation level theory that states that previous experience of pain moderates pain reports and concurs with the findings of Scott and Gijsbers (1981) and Walker (1971) who found that more experienced athletes could tolerate more pain. Recently, Thornton, Sheffield and Baird (2017) found that pain tolerance was higher in novice high-contact athletes at one-year follow-up compared to those who did not continue to play at one year; this suggests that high-contact athletes may learn to cope with pain. However, there were also differences at baseline suggesting individual differences play a role. Thus, both learning and individual differences in pain which may influence choice of sport, may account for the differences observed. Previous studies have found that competitive coping and better pain coping strategies are used more frequently by high-contact athletes during experimental pain (Manning and Fillingim, 2002; Ord and Gijsbers, 2003). These individual differences warrant further investigation.

High-contact athletes' performance was also not hampered by pain on the motor task whereas low-contact athletes and non-athletes were: importantly performance was both slower and poorer in the pain condition suggesting there was no speed-accuracy trade off (Heitz, 2014). It may be that high contact athletes did not use attentional resources on the pain and performance did not suffer as a result. Attentional Control Theory (Eysenck, Derakshan, Santos and Calvo, 2007) suggests that when performers are anxious their attentional control is reduced and attention to threat-related stimuli (often task-irrelevant) is increased and, thus performance suffers. If this is the case, the high-contact athletes may not have viewed the pain stimulus as threatening due to having more experience of pain or perceiving it to be less intense than their usual painful contact in sport. Indeed, the cold pressor was rated as less pain intense by the high-contact athletes, and their pain performance was similar to their performance when not in pain. It may be that, due to their experience of frequently performing in pain, high-contact athletes chose or were able to complete the task in pain more quickly and were, in part, more accurate because they experienced the pain for less time. Future studies could aim to keep the level of pain relatively constant across groups to examine these performance differences. Of course, the detriments in performance in pain in the low-contact athletes and non-athletes suggests their attention was diverted, at least in part, towards the pain which they rated as more painful and probably found more threatening. Assessing threat, using cardiovascular measures for example (Jones, Meijen, McCarthy and Sheffield, 2009) and attention, using eye-tracking measures for example (Heathcote et al., 2017), may help corroborate these speculations.

Task difficulty did not moderate performance in the low-contact and non-athletes in pain compared to no pain and so we rejected hypothesis two. Attention diversion effects were not magnified in the more difficult conditions in the low contact athletes and non-athletes; it is noteworthy, however, that high-contact athletes hit most targets in the difficult pain condition, whereas low-contact athletes and non-athletes hit most targets in the easy non-pain condition. There was a difficulty by group interaction for time taken and targets hit. Both athlete groups completed the difficult motor task more slowly than the easy motor task, whereas there were no differences in the non-athletes. High-contact athletes hit similar numbers of targets in the difficult and easy conditions, whereas the low-contact athletes and non-athletes hit fewer targets in the difficult condition

The picture in the cognitive task was dissimilar: there were no interactions between pain and group. This suggests that the in high-contact athletes there were similar pain-related performance decreases as those observed in low-contact athletes and non-athletes and that the ability to divert attention away from the pain towards the task was not translated to a non-motor task. Indeed, there were no group differences in pain ratings in the cognitive task. Thus, coping with pain by shifting attention to a second task was not an ability the high-contact athletes demonstrated in a less familiar task, which they would not frequently experience in pain unlike the target-hitting motor task.

All performers reported exerting more effort when in pain compared to when not in pain in line with previous research (Evans and McGlashan, 1967). Paradoxically for the low-contact athletes and non-athletes, these increases in effort did not result in better performance. Importantly, there was no significant pain by group interaction which might have accounted for variations in performance. But high-contact athletes reported putting in more effort in the motor tasks compared to the cognitive tasks; this could be a result of the differences in time it took to complete both tasks, or the nature of the cognitive task.

One limitation of this study is that the cognitive task took substantially longer for the participants to complete than the motor task and a small number of participants did not complete the task. This may account for the variation in pain ratings and contribute to the absence of performance differences in this condition. Performers reported significantly more pain in the cognitive task compared to the motor task, as a result of having to keep their foot in the ice water for longer. Accordingly, in future the timings of each task should be made similar to make both tasks more comparable. In addition, it may be possible that the motor task was more familiar to the high contact athletes based on their sports (rugby, American football). As such, it may be that these athletes were at an advantage compared to others, although it should also be noted that there were no difference in performance between groups when not in pain. Moreover, the low contact athlete group included a majority of regular exercisers who also may be less familiar with competition and may have been less likely to be competitive.

A further limitation to this study is the issue of self-reporting of pain. Liston et al. (2006) examined reporting of pain in rugby players and commented on the culture of playing hurt. They stated that many athletes are reluctant to admit to feeling pain because of the pressures of competition. In the case of the high-contact athletes, this culture may be something they have experienced in their sport and this may have affected their responses. The low-contact and non-athletes on the other hand may have been more likely to admit to feeling pain because they do not have the experience or pressure of having to play hurt and admitting to being in pain does not disadvantage them in the same way as it might for high contact athletes. Furthermore, the findings of this study cannot be generalised beyond college-aged males.

This study adds to the limited literature available relating to how athletes cope with pain. It has been demonstrated that there are differences in performance between high-contact, low-contact and non-athletes when in pain according to type of task and task difficulty. The ability of high-contact athletes to maintain motor performance in pain whilst others cannot, suggests that these athletes have different approaches to and perceptions of pain. The mechanisms behind these differences warrant further exploration. As pain can limit what an athlete achieves, the mechanisms behind these differences warrant further exploration. Pain can have an impact not only on performance, but also on adherence, persistence and effort (Thornton, Sheffield & Baird, 2017). This has implications for athletes, coaches as well as physiotherapists who may work with injured participants. As such, there is scope for a great deal of further research to be undertaken in this area.

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Figures and Tables

Legends

Figures

Figure 1: Motor Task Performance for Targets Hit

Figure 2: Motor Task Performance for Time Taken (in seconds)

Figure 3: Cognitive Task Performance for Time Taken (in seconds)

Tables

Table 1: Means ± Standard Deviations of Performance and Pain Ratings in Motor and Cognitive Tasks and Major and Minor Injuries by Athletic Status.

Figure 1

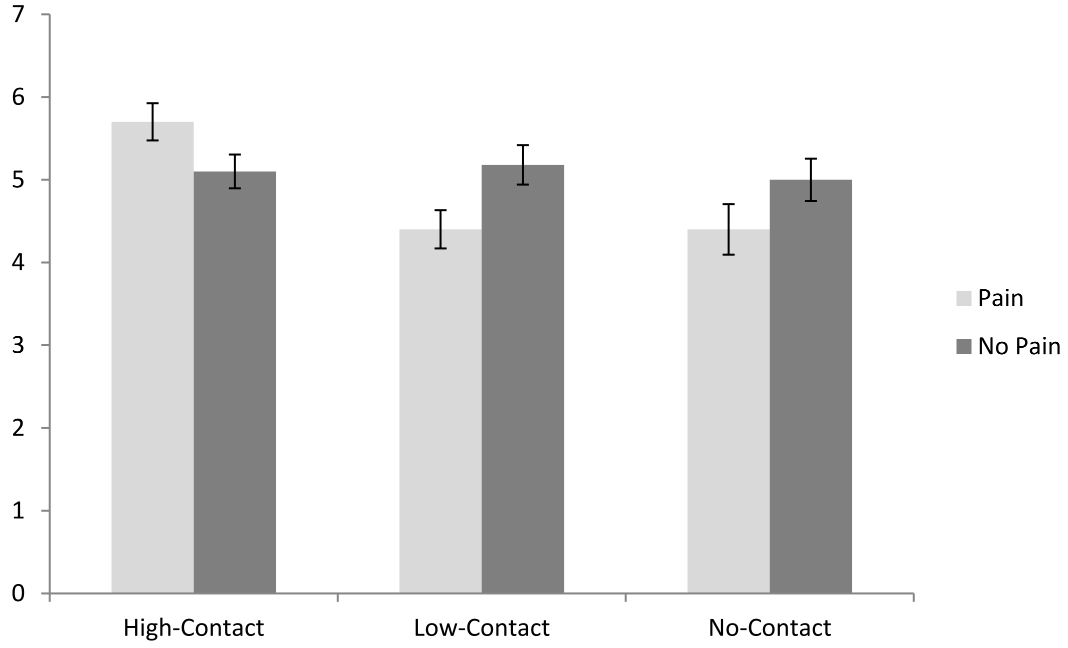

Figure 2

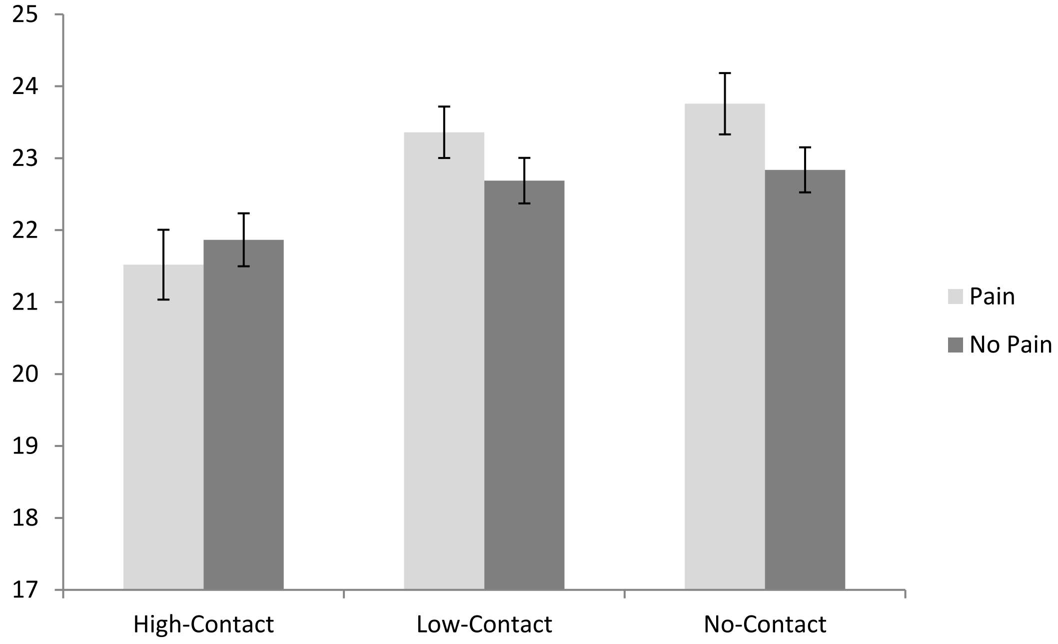
25
24
23
22
21
20
19
18
17
High-Contact
Low-Contact
No-Contact
Pain
No Pain

Figure 3

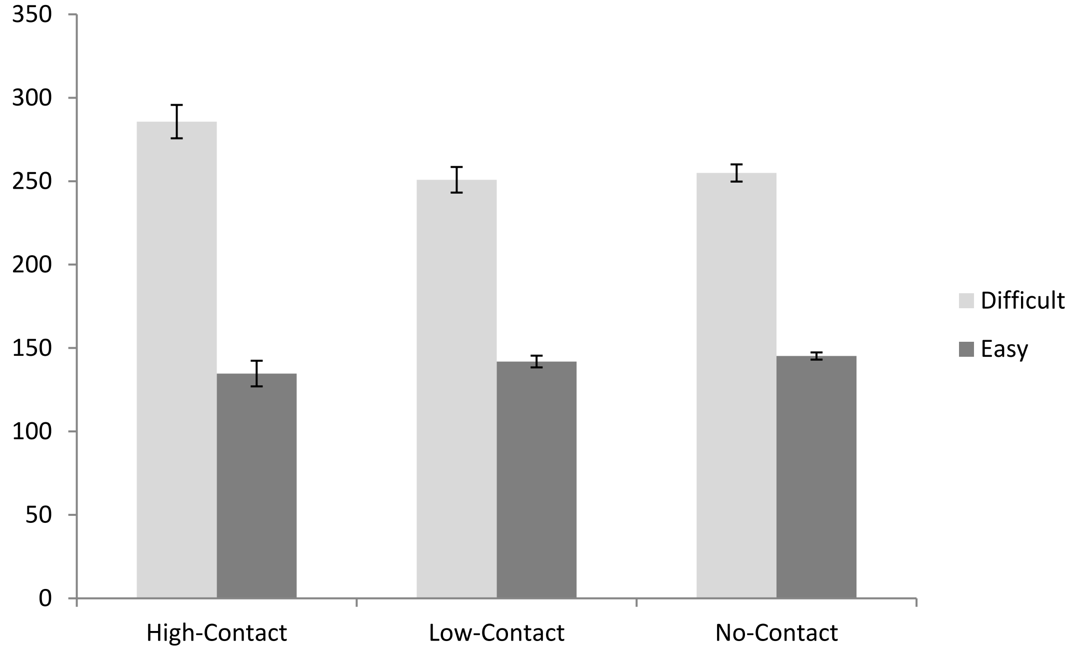
350
300
250
200
150
100
50
0
High-Contact
Low-Contact
No-Contact
Difficult
Easy

Table 1.

	High-Contact				Low-Contact				Non-Athletes			
	Hard		Easy		Hard		Easy		Hard		Easy	
	Pain	No Pain	Pain	No Pain	Pain	No Pain	Pain	No Pain	Pain	No Pain	Pain	No Pain
Motor Task: Targets Hit	5.84 ± 1.54	5.16 ± 1.24	5.56 ± 1.66	5.04 ± 1.64	4.32 ± 1.65	4.56 ± 1.63	4.56 ± 1.63	5.80 ± 1.52	3.95 ± 2.31	4.66 ± 1.74	4.85 ± 1.49	5.33 ± 1.52
Motor Task: Time (sec)	22.62 ± 4.07	22.94 ± 2.76	20.41 ± 2.21	20.80 ± 1.95	24.62 ± 2.13	23.51 ± 2.37	22 .10 ± 2.27	21.87 ± 1.79	23.82 ± 2.54	23.34 ± 1.90	23.69 ± 3.03	22.33 ± 2.07
Cognitive Task: Time (sec)	281.85 ± 71.04	288.05 ± 71.57	138.63 ± 61.10	131.00 ± 47.61	249.75 ± 27.77	237.58 ± 22.47	140.10 ± 15.04	140.49 ± 16.49	259.16 ± 32.12	249.95 ± 29.44	148.16 ± 13.43	143.99 ± 13.46
Pain Ratings: Motor Task	33.16 ± 20.79		33.64 ± 20.95		63.11 ± 17.95		61.36 ± 17.66		70.95 ± 14.15		63.43 ± 21.46	
Pain Ratings: Cognitive Task	41.96 ± 23.10		40.96 ± 21.26		68.36 ± 22.09		66.52 ± 18.19		69.67 ± 16.31		71.10 ± 17.24	
Minor Injuries	37.45 ± 39.15				5.60 ± 7.65				.43 ± .87			
Major Injuries	4.08 ± 2.84				1.40 ± 1.44				.43 ± .87			